Review

Influence of stress and emotions in the learning process: The example of COVID-19. A narrative review

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Abstract: Emotional instability and stress are main disturbances that condition the learning process, affecting both teachers and students. The main objective of this review is to analyze the influence of stress and emotions (as part of stress) on the learning process. The quality and intensity of emotions will not depend exclusively on a particular situation, but also on the subjective evaluation that the person makes of the situation in terms of a set of assessment dimensions. Emotions lead to sentimental, cognitive, behavioral and physiological changes, which will have a strong influence on intellectual performance. Stress is a physiological mechanism that the organism develops to adapt and survive in external and internal environments. Although it seems that it is a general pattern of response to emotions, it could be assumed that each emotion seems to have its own pattern of physiological reaction. In conclusion, extreme stress situations can generate anxiety and frustration in students. The activation of coping strategies constitutes a key mechanism for dealing positively with problems and challenges, generating positive emotions essential for the self-regulation of learning.

Keywords: emotions; emotional intelligence; intellectual performance; learning; stress

1. Introduction

Learning involves the interaction of cognitive, emotional and physiological elements. In this context, emotions are considered a very important part of the knowledge acquisition process. The Greek philosopher Plato (427-347 b.C.) already indicated that "all learning has an emotional basis". Nevertheless, there are many definitions for emotions, and no definition is considered unanimous. In addition, stress is not only a negative aspect, it is also necessary in learning, being a positive aspect when it is under control (1-4).

According to Scherer et al (5), emotions occur when a person evaluates an event or situation as important. For instance, the most recent stress situation (COVID-19 pandemic) has caused an emotional disturbance in the general population and in the field of education in particular. A consequence

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of negative emotions is stigmatization, by which students are mentally affected by continuous fear experiences. This occurs because emotions are accompanied by sentimental, cognitive, behavioral and physiological changes (6-8).

In 2020, the World Health Organization (WHO) declared pandemic status to COVID-19 infection due to the alarming levels of virus spreading into the population (9). The fears generated by exposure to COVID-19 resulted in anxiety and states of stress, in all people and particularly in education actors (teachers and students). Although, direct measures were taken to safeguard the well-being of both teachers and students, the pandemic situation altered their emotional state, leading to burnout and decreased learning ability (10-13). Other pandemics, such as in the influenza pandemic, high levels of stress, anxiety and low mood were observed in this case in healthcare workers (14). These situations undoubtedly lead to increased fatigue and decreased intellectual performance. In the field of education, the pandemic situation has forced students to be at home, not attending universities and high schools, or alternatively attending in small groups. Meanwhile online classes have certain advantages, some students, particularly those studying health sciences, require more resources making it difficult to receive suitable classes (16,17). Otherwise said, students who usually follow their studies on a face-to-face basis are not very familiar with the on-line experience undergoing a systemic shock.

2. Objective

The main objective of this narrative review is to analyze the influence of stress and emotions (both components interconnected) in the learning process. The analysis will be focused in university students in several key points that are interrelated and at the same time, have a direct influence in the learning process. COVID-19 pandemic will be taken as a recent example of learning disturbance due to stress and emotion. The learning process represents a stress by itself, but at the same time is influenced by emotions. Finally, we wanted to know how emotions derived from stress response have influence in intelligence, and in particular in talented individuals. Particular aspects such anxiety, fear and depression will be analyzed in different subsections in this narrative review, trying to understand in more detail their influence in the learning process.

In addition, we present information from a physiological point of view as a key element for understanding the role of emotions in the systemic response. This information could open interest for future pharmacological research. In this context, emotions help to promote learning by stimulating the activity of neural networks and reinforcing synapses (neuronal connections). At the same time, the central nervous system (CNS) is plastic, allowing to change neuronal connections in response to external and internal factors. In the learning process, emotions open the door to all these changes. Emotions follow complex reaction patterns, involving experiential, behavioral and physiological elements such as anger or fear in stress moments. These patterns are subjectively experienced as strong feelings usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body. Therefore, emotions play a fundamental role in learning facilitating the consolidation of memories. Those experiences that are associated with a high emotional charge last more easily in the memory. All these aspects were presented in more detail in the following sections.

3. Methods

To conduct this narrative review, a comprehensive literature search was conducted using the databases PubMed, Ovid MEDLINE and EMBASE and the following search terms “EMOTIONS”, LEARNING” “EMOTIONAL INTELLIGENCE, "COVID-19", and "STRESS". Then, we combined some terms such as “LEARNING AND EMOTIONS” and “LEARNING AND STRESS” to obtain more specific information. First, we have carefully read and selected the summaries of the articles. It should be noted that many of them presented very similar message. Therefore, we selected those that communicate the data in a simple way. Then, we read in more detail and analyzed those important aspects that could contribute to the development of the review.

4. COVID-19, an example of learning disturbances due to emotions and stress

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Emotions are manifested as a response to manage against environment changes trying to maintain subject's well-being (18). The COVID-19 pandemic is the closest example that undoubtedly has generated fear and anxiety (negative emotions) in many segments of the population (12). In the university context, Othman et al (19) reported that students were susceptible to developpe stress and depression. This could clearly be amplified by the isolating situation that the pandemic generated. In this context, stress and anxiety difficulted learning and increased dropout. Therefore, students must balance between individual stressors and education demands (19-21). In general, stress tends to be seen as a negative condition at the beginning, although it is key for adaptation at long term (22,23). This occurs because stress response is mediated by the sympathetic-adrenal-medullary axis (SAM) (a neuroendocrine stress-response system), in particular by the hypothalamic-pituitary-adrenal (HPA) axis, culminating in the release of adrenal hormones such as cortisol. However, at long term, hormones released are involved in the regulation of the immune system and inflammatory activities, contributing to such adaptation (2,23).

On the other hand, teaching during a global pandemic was challenging (24-27). However, before the COVID-19 outbreak, the mental health of young adults was already a global concern. Early reports during the COVID-19 pandemic showed that students did not prefer e-learning *vs* face-to-face teaching (28). However, in the last moments of pandemic, the majority of studies reported positive perceptions of e-learning (29). The change in this tendency occurred because learning-centered approaches were used to facilitate access to contents. Despite all advantages, e-learning was not perceived positively in all academic contexts, particularly in health science education. In this line, the main drawback of this e-learning was the impossibility of live practices necessary to acquire future professional competences (30,31). Moreover, additional study-related worries have been described in the vast majority of both graduate and undergraduate students (32). Most of the studied participants were worried about concentration capacity, academic progress, future plans and academic performance. However, the study of Copeland et al. (33) conducted in USA found that students enrolled in a campus wellness were more confident and optimistic that their home quarantined counterparts. In this line, a study carried out at our own University (Valladolid), Odriozola-González et al. (34) studied the emotional impact of the COVID-19 pandemic situation. They found that around 25-30% of students surveyed reported moderate to extreme severe anxiety, depression and stress scores as a result from the fear of e-learning during quarantine COVID-19 pandemic. Finally, a systematic review and meta-analysis compared the mental health of nonquarantined and quarantined people. Isolation in quarantine was found to be an independent risk factor for adverse mental health outcomes, increasing 2.8-fold the risk of depression 2.0-fold anxiety and 2.7-fold stress response disorders (35). Another study performed on 932 participants showed that people in isolation were at greater risk for anxiety and depression (36).

5. Stress and the learning process

Evidence strongly assess that stress has a key influence in the learning process. First of all, stress affects memory recall. It is well known to most students that the acute stress undergone when facing an evaluation test can make difficult to recall information that might be available in less stressful circumstances (37). Nevertheless, the impact of stress on the process of encoding information into memory is controversial. Some authors defend that stress impairs memory functions (38), meanwhile others show that stress enhances memory encoding (39). However, it is difficult to determine the factors that are responsible for the reported discrepancies. It seems that stress could be considered as a positive component when it is under control and a negative factor when the circumstances are clearly adverse (no possibility of control) (1).

Stress negatively affects the physical and mental health of students and hinders academic performance (40,41). During the first years at the university, students experience high levels of stress and anxiety, largely due to the new situation and the competition between students themselves (42,43). Learning stressors are also associated with personal stressors, such as family demands, work, or sports, that compete with the demands of education. Undoubtedly, the pressure felt by the student exacerbates their state of stress and anxiety (43).

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Stress acts on different neural pathways and brain locations critical for memory. It has rapid effects by producing an increase in dopaminergic and noradrenergic activity in the prefrontal cortex (44,45). It acts as well through the hypothalamus-amygdala axis (HPA) to regulate the secretion of stress hormones adrenaline and noradrenaline (46-50). These hormones stimulate the vagus nerve and ultimately influence the hippocampus, amygdala and prefrontal cortex, among other regions (47-52).

6. Emotions and the learning process

Emotions are interpretations of the internal and external environment. The perceived information is used subsequently for action (2,23). In addition, emotions have a motivational function that predisposes to repeat behaviors linked to positive feelings. In this line, emotion regulation is multidimensional, and includes: (a) awareness, understanding and acceptance of emotions; (b) the ability to control impulsive behaviors during distress; (c) the ability to use appropriate situational strategies to modulate the intensity and duration of emotions; and (d) the willingness to experience negative affective states in order to engage in meaningful life activities (8). Loss of control, stress, anxiety and threat perception have been found to be involved in the reaction to emotions, resulting in increased anxiety and feelings of helplessness (8).

Many different criteria have been used to classify emotions. Ekman (53) indicates that basic/innate emotions have a differentiated facial expression that is universal and easy to identify. However, acquired emotions seem to follow a more complex interpretation pattern depending on whether they are positive, negative or neutral, pleasant and unpleasant, problematic, individual or collective (53,54). Altogether, an adequate classification for emotions could be: a) primary or innate, also called basic, pure or elementary; b) secondary or acquired, also known as social. In general, the primary would include fear, surprise, anger, rage, disgust, sadness, and happiness among others. The secondary includes guilt, shame, contentment, jealousy, acceptance, resignation, and pleasure, among others.

However, in the learning process, classification using the terms “positive”, “negative” and related terms seem to be more appropriate. Therefore, negative emotions affect well-being and provoke a desire to avoid or evade. These include anger, aversion, fear, anxiety, sadness, shame, among others. Positive emotions are considered healthy because they positively affect the well-being of the individual. They favor the way people think, reason and act, including joy, humor, love, happiness, among others. To complete this classification, ambiguous emotions that do not fit with the previous criteria should be considered, including hope, surprise and compassion. Finally, toxic emotions with a very negative component are considered as well in this classification, being envy as the most representative (55). Altogether, COVID-19 was the most clear and recent example indicating how emotions influence the learning process.

In addition, it is also necessary to differentiate between emotions and emotional state. The emotion is characterized by an alteration of the physiological response that predisposes to an organized systemic response (23,56,57). However, emotional state refers to mood, which is of longer duration and lower intensity. Emotions are of short duration and are triggered by a specific stimulus (58). Coming back to the example of COVID-19 pandemic, the first evidence is that the emotional impact on each individual is very particular. For some, their emotional wellbeing decreased as they did not know how to cope with the uncertainty, anxiety, boredom and even sadness that staying at home implied. For others, the same situation was a challenge turning these emotions into positive ones (59-60).

Therefore, it is well known that positive emotions support learning by increasing intellectual, physical and social resources, favoring creative development and improving coping strategies (61,62). These emotions end up modifying the perception of learning and, therefore, the success achieved after the effort. Success should be considered as a non-measurable entity, as it is not an academic grade, a job, a salary achieved, or a qualification from the environment. Success is mainly an emotional and individual state, which is not defined from outside references but from personal introspection. In this context, the concept of success fits with the definition stated by John Wooden in

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1997 (63) "Success is a peace of mind that is direct result of self-satisfaction in knowing you did your best to become the best that you are capable of becoming".

6.1. Physiology of emotions

Kandel et al. (64) reported that the emotional state is composed of an overt element characterized by physical sensations and another characterized by a concrete feeling (conscious process). Both emotional state and feelings are regulated in different anatomical structures. Concrete feelings are regulated by the cerebral cortex, partly the cingulate and the orbitofrontal cortex. Emotional states are regulated by a joint action with nervous, endocrine and skeletal-motor responses. The amygdala is the intercommunication structure of somatic expression of emotions (hypothalamus and brainstem nuclei), and is the system of interpretation of concrete feelings, especially fear (cingulate, parahippocampal and frontal cortex) (65). This occurs because the brain builds a permanent mental image during the emotional state with a mental map that characterizes the state of the body (viscera, musculoskeletal system) (64). When the brain detects emotional stimuli, it sends specific commands to the CNS, NES (neuroendocrine system), ANS (autonomic nervous system) and the musculoskeletal system. This results in different reactions to emotions. The involuntary physiological response seems to be the first reaction to emotion. The psychological response comes after, including the way in which information is processed and finally, the behavioral response that generates a change in mood. Based on the systems involved in emotions, as well as the development of processes and functions, five components are identified (5):

a) Physiological, which fulfils the function of regulation of organ systems, depending on the CNS, ANS and NES (2,66,67). These systems regulate physiological and emotional responses influencing the unconscious and instinctive behavior (important in survival). Many of these innate and primitive behaviors are altered by the brain cortex (68). For instance, human unconscious behaviors such as confidence, hope, joy, guilt and despair, are influenced by conscious moral, social and cultural codes (66,67).
b) The cognitive component is linked to information processing and has the function of evaluation.
c) The motivational component is linked to the CNS which prepares and directs actions. In emotional states there are more active CNS locations (68).
d) Motor expression, which fulfils a communicative function by informing the behavioral reaction and intention.
e) The subjective aspect serves to monitor the internal state of the organism and its interaction with the environment.

The fundamental function of the amygdala (subcortical structure in the internal temporal lobe) is the processing and storage organ of emotional reactions. It produces short-term adaptation, which allows to increase rapid, unconscious responses that, although not very precise, are effective. The central nucleus coordinates efferent information that gives rise to both autonomic (sympathetic and parasympathetic), endocrine and behavioral emotional responses (57,64,69). The amygdala facilitates the formation of stimulus associations and helps to establish the emotional meaning of different situations (70).

Emotional information follows two pathways (one fast and one slow) to the amygdala. A third, equally important pathway (hippocampus-amygdala) underpins contextual conditioning. Through the thalamus-amygdala connections, an affective process with simple sensory features is elaborated, and through the thalamocortical connections, the complex process without affective components is produced. Through the cortico-amygdaline connections the emotional component contributed to the complex information elaborated in the cortex (66,71).

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The final process results in adaptive changes and reorganization of CNS due to its neuroplasticity. These changes occur both by learning and by adaptation to internal or external situations. In this process, activities such as neurogenesis might be considered.

6.2. Non-physiological components of emotions

Emotions have different components: subjective, behavioral and emotional (62,72-75). In this sense, and from the point of view of stress, the influence of personal traits, self-perception and previous experiences must be considered, as they depend to a large extent on the type of stressor (76). This explains why coping requires behavioral and cognitive effort to manage stressful situations. In this context, some strategies are considered to focus on the problem (person-situation relationship) and others on the emotion or emotional disturbances resulting from the stressful situation (77,78).

6.3. Functions of emotions

Most authors focus on the cognitive and intellectual functions of the brain, including thinking, learning and decision-making. However, the brain is not only a center of reasoning, but also an agent of motivation and expression of emotions. Under normal conditions, a balance between the emotional and rational mind is stablished. Emotions shape rational operations and the rational mind adjusts and sometimes modulates emotional decisions (57).

The left hemisphere of the brain, the rational part of the brain, is where structured functions, i.e. language. The right hemisphere, on the other hand, is the emotional hemisphere, which governs subjective feelings, i.e. the ability to appreciate art and music. The emotional part processes much faster than the rational mind, because this last-one establishes the cause-effect relationship, being supported by objective evidence, and it can lead to re-evaluation of the situation, giving the possibility to change a previous decision (68-71).

The part of the brain that manages the emotional mind is the limbic system that is related to the regulation of emotions and behavior, i.e. memory, attention, emotions, personality and behavior (2,76). Also, the amygdala is the key brain structure for emotion management (67,70), providing connections that produce emotional reactions and enable the inhibition of behavior. Therefore, amygdala main function is to integrate emotions by inducing the physiological response and the preparation of the behavioral response. In addition, the amygdala is responsible for coordinating the areas of somatic expression of emotion and the cerebral cortex, responsible for conscious feeling. This means that it plays a key role in the assessment of the emotional meaning of experiences (77,78).

The four important neurotransmitter pathways in an emotional-motivational sense are those mediated by dopamine, serotonin, noradrenaline and endorphin. The release of dopamine translates motivation into action. Upon stress exposure, dopamine mediates by selecting the optimal response for coping with stressful situations (76). Different hormones and neurotransmitters complement this reward emotional response such as testosterone and oxytocin respectively (76). Finally, the neurotransmitter serotonin, known as the "mood hormone", is related to well-being and helping to manage stress. In addition, serotonin inhibits anger and regulates temperature, mood, appetite, sleep, falling in love, among others (76). The result is that emotions have three clear functions: adaptive, social and motivational (79,80) (Table 1).

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Table 1. Emotional aspects. Relationship between functions, components and organ systems.

Emotional function	Emotional component	Physiological function (organism systems)
Event evaluation	Cognitive component	Information processing (CNS)
System regulation	Neurophysiological component	Support (CNS, ANS, NES)
Action preparation and direction	Motivational component (action tendencies)	Executive (CNS)
Communication of reaction and behavioral intention	Motor expression component (facial and vocal expression)	Action (SNS)
Monitoring of internal state and organism-environment interaction	Subjective feeling component (emotional experience)	Monitoring (CNS)

CNS = central nervous system. ANS = autonomic nervous system. NES = neuroendocrine system. SNS = somatic nervous system.

All emotions, pleasant or unpleasant, are necessary and useful, as they allow to quickly assess situations, to inform if something is important for well-being. They are very important for increasing learning capacity and memory, all of which will allow them to play an important role in decision-making (81).

Coming back to the example of COVID-19, all functions of emotions were altered at the current time of pandemic. However, not all people were equally vulnerable to these events. Johnson et al. (82) in a survey study, analyzed the impact of COVID-19 on the Argentinean population and observed a high level of uncertainty and fear in the population in relation to COVID-19. Similar data were obtained in India, where they expressed a high degree of concern and uncertainty about COVID-19 and a higher percentage indicated the need for psychological support to reduce the impact on their mental health (83). Alcalá et al. (84) have observed that most students felt fear, anxiety, stress and uncertainty related to COVID-19 infection. Other authors (85) have obtained similar results in studies on the return to clinical learning after the COVID-19 outbreak. Depending on the vulnerability of the subject, and once the acute phase is over, it can be observed a functional or adaptive coping response, or a dysfunctional, maladaptive or counterproductive coping response (86). Stress is one of the risks of adaptive dysfunctions. In this sense, Buitrago et al. (87) listed possible reactions in situations of intense stress such as the COVID-19 pandemic, affecting mental health. Altogether, emotions precede feelings (88).

Regarding the mechanisms involved in stress, understanding the biological basis on executive functions may provide more insight into the mechanisms underlying the effects of stress on cognition (89,90). One of the main functions of emotions is to facilitate the appearance of appropriate behaviors facing stress (81). The expression of emotions allows to predict the behavior associated with them. In this line, performance of cognitive tasks prior to an executive task can modulate performance (91,92). Nevertheless, disturbances coming from amygdala such as fear, can affect learning and memory storage (93-95). Therefore, knowing how to modulate emotions in stressful situations could promote effective learning. Emotions can act on the psychological processes responsible for focusing attention or solving problems (96). This emotional self-regulation, understood as the ability to motivate oneself, would be one of the dimensions encompassed by the so-called emotional intelligence (97).

6.4. Emotional intelligence

Many authors have asserted that emotional intelligence (EI) contributes to an individual's ability to adapt socially, work more effectively in teams, perform better, and cope more effectively with stress and other forms of environmental pressure (98,99). Therefore, EI functions as an essential predictor of students' learning and cognitive health (100,101). For instance, students and faculty have

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managed the learning process during the pandemic through their emotional intelligence and cognitive engagement in blended learning environments (102). Higher education institutions have managed the problem of campus closure by switching from face-to-face to online classes (103).

EI involves the perception, processing, regulation and management of emotions. From a technical point of view applied to learning, EI is defined as a capacity-based skill that enables training in specific competences that can be directly applied to a specialized field. Otherwise said, EI can be used to address specific aspects of the teacher-student relationship (103). EI includes everything that is not covered by academic intelligence, such as impulse control, self-motivation and social relationships, among others (54,104). Therefore, EI links the thinking part of the brain (neocortex) with the emotional part and the limbic system (105,106).

The application of EI has been proposed in clinical, social, educational and organizational settings (107). Various studies (106-109) have explored the relationship between individual differences in EI and academic outcomes. According to their results, it appears that the construct of trait EI may serve as a moderator of the relationship between intelligence and school performance.

The abilities that constitute the EI construct are multiple. However, at present two major models of EI can be found: a) ability model, which studies abilities that deal with affective information (106,109); and b) mixed models that link emotional and cognitive abilities with personality (105). From the ability model, EI is expressed as a set of abilities to perceive, access, understand and regulate emotions to promote emotional and intellectual growth (109). In this context, self-awareness and self-motivation (dimensions of EI) have a direct, positive and significant impact on study habits (110). However, other dimensions of EI (emotion regulation and social skills) have less influence. The structure of emotional awareness is based on cognitive schemes that are different among individuals and are strictly dependent on past experiences expressed through language. Emotional awareness undergoes a structural transformation following a hierarchical development defined by five levels (in progressive order): physical sensations, action tendencies, individual emotions, mixtures of emotion and mixtures of emotional experience. Therefore, organization of emotional experiences is based on the varying complexity of emotional representations (111,112).

Self-awareness is reinforced by self-care behaviors such as exercise and journal writing. In general, students are an intelligent population and therefore have good study habits in any condition. Nevertheless, students with higher levels of EI have a high level of cognitive engagement in many conditions. In this sense, it has been communicated that individuals who show higher levels of EI are likely to be able to identify emotional states in themselves and others. They can use the information to better control the environment according to the situation. In this sense, EI teaches the individual to move from behaviors that seek self-gratification to ones in which gratification is received by understanding emotional needs in himself and others (113).

6.5. The impact on talented individuals

The influence of stress and emotions has to be mentioned on those individuals with special learning qualities. These individuals organize information more accurately and efficiently than others (114,115). Talented subjects are unique individuals who are endowed with special attributes or characteristics that make them develop, learn and perform skills more easily than others in similar environments (116). In the fields of art, sport and science, talented individuals acquire a large number of complex patterns to store new knowledge about what actions or processes should be performed for structured learning (117). Altogether, due to these qualities, talented individuals can manage very efficiently stress and emotions in the learning process.

7. Discussion

Stressful situations, such as the COVID-19 pandemic situation, can bring out negative emotions, resulting in disturbances in the learning process, generating anxiety and frustration in students. However, positive emotions have an amplifying character, helping to perceive and interpret everything around properly, helping to understand, learn, manage and improve life in all aspects. Therefore, the activation of coping strategies creates key mechanisms for dealing positively with problems

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and new challenges. Altogether, this response generates positive emotions that are instrumental for the self-regulation of learning.

Therefore, emotions can condition learning and for this reason, it is important to identify and manage emotions. Regarding the information presented in this review, we propose for future research to test some strategies to mitigate the negative impact of stress and emotions in the learning process. Techniques of meditation and mindfulness could be implemented to reduce stress and improve mental health. These techniques could help in cognitive restructuring to identify, evaluate and change wrong thinking. In addition, relaxation techniques could be useful for physical recovery. Muscular and respiratory systems are the main targets for relaxation. We propose to test in a future research a protocol in which students have to identify the moment of the day when stress appears and perform routinely relaxation techniques. Reduction of anxiety should be verified in this proposal. Finally, decipher in more detail strategies followed by talented individuals could be an interesting area for future research. In this line, an increase of attention in the study will help to manage academic situations of stress.

Regarding limitations, as a narrative review some articles related to the topic could be missed, although extensive literature has been presented. Since sex can influence feelings of anxiety and frustration, articles regarding this particular aspect were scarce and this aspect was not afforded in the review. Finally, more physiological research is necessary to correlate anxiety feelings with activation patterns of the CNS. In this context, recent research has revealed new insights into the role of the insular cortex in emotional processing and the interaction between the insula and the amygdala (118). Changes in these patterns after activation of coping strategies could be an interesting area for future research and pharmacological interventions.

8. Conclusions

Stress and emotions have a main influence in the learning process. COVID-19 pandemic was the more recent reference of social stress and people isolated in quarantine were at greater risk for anxiety and depression. Students were one the population segments affected in learning process. In this context, stress tends to be seen as a negative condition in the learning process because impairs memory functions. However, other evidences indicate that stress enhances memory encoding. Therefore, the role of stress in encoding information needs further investigation. In addition, learning stressors are associated with other stressors, such as family, work or sports demands. On the other hand, emotions can influence the learning process. Positive emotions are healthy and can favor optimal learning. However negative or toxic (very negative) emotions can impair significantly health and the learning process. Emotional states are regulated by a combined function of nervous, endocrine and skeletal-muscle systems, being amygdala the intercommunication structure for somatic expression of emotions. In conclusion, modulation of emotions in stress could promote effective learning through focusing attention or solving problems. This emotional self-regulation is known as emotional intelligence and it is used to address specific aspects not covered by academic intelligence. Talented individuals are a reference for future research because they can manage very efficiently stress and emotions in the learning process.

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